Building Collaboration Tools and Access to On-Line Facilities

Deb Agarwal and Sonia Sachs
Lawrence Berkeley National Laboratory
Berkeley, CA 94720

A collection of emerging technologies, together with work in distributed data acquisition and dissemination, as well as in distributed computing completed by the DOE - Energy Research community over the past several years, has enabled the creation of distributed scientific and industrial laboratory environments. These environments, called “collaboratories”, provide complete location-independent collaborative access to instruments, data acquisition and analysis resources, as well as to collaborating researchers.

Network-based facilities will allow researchers at different locations to collaborate on experiments as if they all were together in the same laboratory. The expected value of these geographically distributed environments includes substantially increased effectiveness in doing science, and an enabling capability for analytical and high-value production use by industry.

The Distributed, Collaboratory Experiment Environments (DCEE) Program* consists of four projects that were established to build prototype remote experiment and collaborative environments. Information about the DCEE projects is available via the WWW page: *http://www-itg.lbl.gov/DCEEpage/DCEE_Overview.html*.

The work undertaken in this project represents some of the research and development of the mechanisms and infrastructure required to make collaboratories a reality. Some of these mechanisms have already been developed. Several other mechanisms, such as data dissemination, resource management for the sharing of experiment control, safety and security, electronic notebooks, elements of telepresence, and integrated user interfaces need further research and development.

The pilot application for these collaborative tools is the Advanced Light Source (ALS) Beamline 7.0 at the Ernest Orlando Lawrence Berkeley National Laboratory. The ALS is a particle accelerator and is a source of very high brilliance soft X-ray beams.One experimental facility is the Spectro-Microscopy Facility Beamline 7.0. Information about the Spectro-Microscopy Facility is available via the WWW page: *http://www.uwm.edu/~tonner/bl7intro.htm.*

Through this project, the Spectro-Microscopy Facility will be opened up to “users” from a wide range of organizations. The goal is to build software that will not only put the ALS Beamline 7.0 “on-line”, but will also serve as building blocks for future collaboratory development.

Component Descriptions

There are many software components required to make collaboratories a reality. The traditional tools utilized by researchers include paper notebooks for recording experiment data, turn-key experiment control systems, and security accomplished through isolation, obscurity, or lock and key. The tools required to make collaboratories a reality include electronic notebooks, on-line instruments, telepresence facilities, security, data dissemination mechanisms, resource location and coordination facilities, and distributed file systems.

Traditional videoconferencing tools do not provide enough feedback to a remote researcher who needs to be able to “walk” around the experiment site and interact with people. Telepresence facilities include videoconferencing capabilities, remotely controllable pan/tilt/zoom/focus cameras, wireless audio and tools for rendezvous and launch of sessions.

The experiment control software, which is traditionally a turn-key closed system, must be reconfigured to allow

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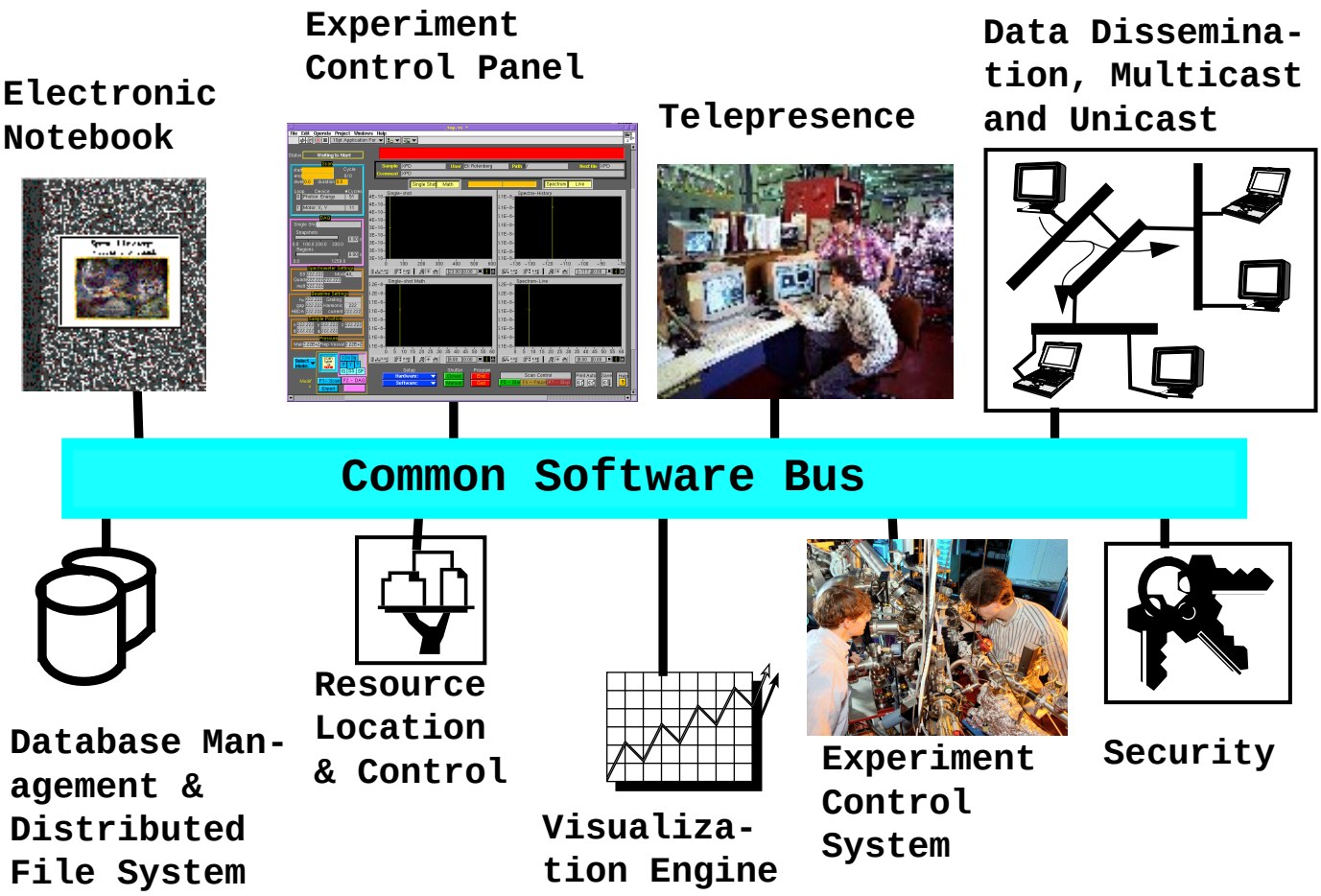

The components of the collaboratory environment

monitoring and control over the network. In addition, common data dissemination tools provide high performance, efficient, and reliable dissemination of experiment information to collaborators through unicast and multicast based communication mechanisms.

The Electronic Notebook (EN) allows storage and retrieval of information generated as collaborating physicists run and analyze experiments. The electronic notebook thus provides an interface for organizing, archiving and searching all the information developed during a collaboration. The notebook is based on the integration of an electronic notebook engine with the OPM database management system [*http://gizmo.lbl.gov/opm.html*] developed at LBNL. The electronic notebook engine communicates with experiment control software and all other collaboratory components in order to automatically acquire experiment and collaboration information. The details of this project are presented in *http://www-itg.lbl.gov/~ssachs/notebook/project.html*.

Architecture

The underlying infrastructure of the environment is a common software bus. The bus allows each software tool to be built as a plug-in module with a common interface, common security, and common communication mechanisms.

The goal is to provide a single integrated environment that is easily extensible and scalable. New software tools can be plugged into the bus and register with the resource manager. Other tools can contact the resource manager and request use of the resource as needed. The user is presented with a single login to the collaboratory environment and all credentials for the use of the various tools are obtained based on the single login. Security is achieved through a combination of public and private key mechanisms.

Summary

The first phase of the project is now complete and the remote researchers are able to monitor experiments and interact with the researchers at the ALS. For further information about the Spectro-Microscopy Collaboratory or the DCEE program see *http://www-itg.lbl.gov/BL7Collab.html* or *http://www-itg.lbl.gov/DCEEpage/DCEE_Overview.shtml* respectively.